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THE RELATIONSHIP BETWEEN EARLY MANUAL COMMUNICATION AND LATER ACHIEVEMENT OF THE DEAF.

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AN INVESTIGATION WAS UNDERTAKEN TO DETERMINE WHETHER EARLY MANUAL COMMUNICATION WITH DEAF CHILDREN INFLUENCES THEIR SUBSEQUENT ACQUISITION OF (1) INTELLIGIBLE SPEECH, (2) READING ABILITY, (3) SPEECH READING ABILITY, (4) WRITTEN LANGUAGE, AND (5) PSYCHOSOCIAL ADJUSTMENT. THE DESIGN INVOLVED MATCHED PAIRS OF SUBJECTS BECAUSE OF THE LARGE NUMBER OF VARIABLES WHICH NEEDED TO BE CONTROLLED. EARLY MANUAL COMMUNICATION WAS THE INDEPENDENT VARIABLE. ONE SUBJECT OF EACH MATCHED PAIR WAS A DEAF CHILD WHO HAD LEARNED MANUAL COMMUNICATION FROM INFANCY. THE OTHER WAS A DEAF SUBJECT WHO HAD NOT LEARNED MANUAL COMMUNICATION FROM INFANCY. FROM 5 SCHOOLS FOR THE DEAF, A PRELIMINARY MATCHING LED TO 105 CHILDREN OF DEAF PARENTS BEING MATCHED WITH 337 DEAF CHILDREN OF HEARING PARENTS. ALL CHILDREN WERE 10 YEARS OF AGE OR OVER. DATA COLLECTED BY PARENTAL QUESTIONNAIRES WERE USED IN PAIRING OF CHILDREN. PAIRS OF SUBJECTS WERE MATCHED AND TESTED WITH REGARD TO SEVERAL VARIABLES. THE DEAF CHILDREN WHO HAD LEARNED TO COMMUNICATE MANUALLY FROM INFANCY WERE SUPERIOR TO THE GROUP WITHOUT EARLY COMMUNICATION EXPERIENCES IN SPEECHREADING, READING, AND WRITTEN LANGUAGE. IT WAS CONCLUDED THAT, WHEN THE INFLUENCE OF EARLY MANUAL COMMUNICATION ON THE LANGUAGE OF DEAF CHILDREN IS PRESENT, THIS INFLUENCE HELPS THE DEVELOPMENT OF CONVENTIONAL LANGUAGE SKILLS. (JC)

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The Relationship Between Early Manual Communication and Later Achievement of the Deaf

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I. INTRODUCTION

Educators of the deaf tend to adopt one of several fundamentally different positions with regard to the most desirable method of conversing with deaf children in light of their communication handicap.

Some educators support the position called oralism which holds that deaf children should be taught exclusively oral conversation, without signs or finger-spelling.

Another group adheres to the simultaneous method. This consists of the use of both manual communication (signs representing units of thought, and words spelled on the hands) and vocal communication simultaneously.

A third position advocates the elimination of signs, restricting manual communication with the child to spelling each word on the hands, while simultaneously speaking. This method is referred to as the Rochester method.

The latter two methods are generally introduced to the deaf child in school after he is eleven or twelve years of age. Until that age, the child is taught orally. Methods of communication outside the classroom may vary.

A fourth method, standard practice in Russia and being used under controlled conditions in some schools for the deaf in the United States, is an extension of the Rochester method to beginning students.

A detailed discussion of these methods as applied in the classroom, their underlying rationales, and their various implications, is not relevant to this investigation. However,

it is important to recognize that the selection of the method of communication employed with and by the deaf child is considered by specialists in education to be a vital issue. The timing of the introduction of the method is also seen as critical.

The deaf child cannot be expected to develop communication skills spontaneously. The major focus in the instruction of the deaf child centers on the language arts, and with the young deaf child, on vocal communication in particular.

Educators of the deaf recognize a need for early communication to simulate the linguistic development of normal hearing children. The awareness has been stimulated by four major historic developments: (a) earlier admission to the primary grades, (b) the establishment of pre-schools for deaf children of four and even three years of age, (c) speech and hearing clinics to which parents may bring their young deaf children for speech and lipreading instruction, and auditory training, (d) assistance to the young deaf child through his parents by correspondence with educators.

The hearing child has already developed much of his receptive and expressive vocabulary before entering school using language as a vehicle for extracting experiences from his environment. The significance of language for the young hearing child need not be elaborated.

Some deaf children also develop a comprehensive receptive and expressive communication system before entering school, a system which can develop without formal instruction and at a rate

similar to that of hearing children if the conditions are appropriate. Many deaf parents communicate with each other, and with their children, both hearing and deaf, through manual means. Deaf infants learn to communicate manually through increasingly discrete manual patterns in much the way the hearing child learns to relate selectively through vocalizations. Signs become less gross just as do the sounds of young hearing children as a function of the developmental process.

It is reasonable to speculate that if a young deaf child learns a manual communication system during infancy and early childhood it will influence his acquisition of conventional language skills such as speech, speechreading, written language, and reading after he enters school. If there is an influence, however, it might not be generalized, but limited to one or two of the above skills. One could logically infer the influence to be either positive or negative.

Several arguments can be made to support the negative position. (a) It could be stated that manual communication has a retroactive and proactive inhibiting effect on the acquisition of English language skills by deaf children because manual communication, specifically signs, is differently and more loosely structured than the English language. (b) The child who has communicated manually in the home has been denied the opportunity to vocalize and to perceive English linguistic structures. (c) With a functional communication system already established, he lacks the motivation to learn more conventional communication skills.

On the other hand, one could argue that there should be a generalized positive influence. (a) The child is well aware of

the concept of language before being introduced to formal language instruction. (b) He should be able to remember vocabulary through association--that the word "boy" for example represents the sign he knows as the hand lifted to the forehead symbolizing the brim of a cap. (c) He may possess a level of cognitive functioning superior to the deaf child without a communication system by virtue of the relationship between language and concept formation. (d) He may have a broader experiential background than his peer without a communication system, thereby facilitating his general educational development. He may be less socially deprived than his deaf peer whose parents cannot communicate readily with him. It should be added that one could not logically infer superior speech sounds on the basis of these arguments, but one might make the inference for the connected speech sounds considered as spoken language.

Many teachers of the deaf, on the basis of their empirical information, explain the success of some deaf children in written language and reading by the fact that they have deaf parents who communicate manually in the home; the same teachers attribute poor development of speech and speechreading to the same observation. If in fact early manual communication influences the development of linguistic skills in deaf children, whether it be in a positive or inhibiting direction, then the implication is clear that the establishment of a communication system in the deaf child before he enters school is relevant to the linguistic success manifest while he is in school.

The investigators wish to underscore two points at the outset of this report.

1. This investigation was not designed to reveal information on the relative educational merits of the various methods of communication employed in programs for deaf children and cited earlier in the Introduction. It limits itself to a study of the influence of a particular communication system learned by some deaf children before they enter school.

2. It is recognized that manual communication might not be the only functional communication system which a deaf child can learn before entering school. It may be that under optimum conditions a deaf child can be taught to vocalize and speechread language with such skill that these communication media become highly functional very early in life. Manual communication was isolated as an independent variable because young deaf children do learn this method of communication with reasonable ease and without formal tutoring. The investigators would also encourage research on subjects who develop a systematic communication system through speech and speechreading or through finger-spelling alone.

II. REVIEW OF LITERATURE

A. The Role of Language

Vygotsky (1962) and many others have written about the interaction between thought and language. The following statement summarizes the position of most scholars interested in psycholinguistics:

> "Language reflects the integrative nature of thinking. Not only does one's language facility correlate highly with maturation and with basic intelligence, but it serves as the hallmark of one's personality. Language is the instrument which structures our view of reality and existence; it permits us to report, or to comment on, those segments of reality which infringe on our senses." (Cleland, 1964, p. 1)

With regard to the developmental process, Carroll wrote:

> "Toward the end of the second year of life the normal child starts an intense use of language to explore his relations with people and things. He learns to ask questions and thus to seek help from other children or adults in learning the names of things, learning the categories in which his language orders the world, and learning the freedoms and sanctions of his relations with others." (Carroll, 1960, p. 749)

It is evident, however, that cognitive functioning of a relatively high order can take place without the mediation of language, as has been frequently demonstrated through the problem-solving tasks assigned to primates. For some unknown reason most psycholinguists have been reluctant to study children who, because of auditory deprivation, have not developed facility in the use of language. What research has been conducted in this area centers for the most part on concept formation, the most comprehensive being that work done by Furth (1961, 1963) and Rosenstein (1959, 1961, 1964).

Furth (1961) concluded that language is not necessary for the basic ability to form concepts, although certain concepts are facilitated by language. Rosenstein (1961) similarly concluded that deaf children can function cognitively as well as hearing children when the level of language used in a task is within their limits.

Hughes (1961) tested deaf and hearing children on perceptual and conceptual tasks, and found deaf children to be inferior to hearing children on verbal conceptual problems. Similarly, Oleron (1953) found the deaf to be inferior to the hearing in conceptualization, attributing this inferiority to the retarded development of the deaf child rather than basic incapacity.

More research is required in this area, perhaps using a design to permit controlling differences in language development. At present, it must be concluded that when a task requiring conceptualization makes use of language, the deaf child proves inferior. Where differences appear, they are likely a function of language inadequacies.

It would appear that increasing the language skills of the deaf child should lengthen the vertical range (on a concrete-abstract dimension) of concepts which can be learned. According to Welch and Long (1940) the more abstract a concept, the greater the demand for verbal functioning. Language, then, facilitates the development of high-order concepts, and language inadequacy sets a limit.

B. Language Development of the Deaf Child

The deaf child, not perceiving auditory symbols, does not develop a communication system spontaneously. Not until he

receives language instruction does he begin to develop such a system. It is conjectured that he is not even aware of the phenomenon of language until he begins to develop such skills.

The normal hearing child, by contrast, has developed elements of a communication system very early in life. By the age of two and one-half years, the hearing child has acquired most of the phonemes necessary for vocal communication (Chen and Irwin, 1946). By age six, he has developed an expressive oral vocabulary of approximately 2500 words (Smith, 1926) and a receptive vocabulary of approximately 23,000 words (Smith, 1941).

Numerous investigations have compared various aspects of the language of deaf and hearing children (Calvert, 1962: Heider and Heider, 1940: Myklebust, 1960: Simmons, 1962). The results of these investigations point up without exception that deaf children have a generalized language deficit.

C. Psychosocial Development of the Deaf Child

DiCarlo and Dolphin (1952), after reviewing the literature through 1952, concluded that the information on the social and personality development of the deaf was inconclusive. To the present, these areas of investigation remain relatively obscure with regard to the deaf child.

Gesell (1956) applied his scales of child development to the deaf child and found that the deaf pre-school child was generally underdeveloped and particularly so in those areas concerned with social and emotional adjustment.

Levine (1957) administered the Rorschach to a group of adolescent deaf girls. The protocols revealed undeveloped personalities with delayed emotional maturity, rigidity, and

egocentricity. She attributed these findings to communication deficiencies.

Heider (1948) reported on the social behavior of deaf children in an experimental play setting. They tended to be dominated by hearing children inserted into this setting, the hearing children using language to exercise control. Avery (1948) found aurally handicapped children to have a normal social quotient as measured by the Vineland Social Maturity Scale.

Psychosocial veriables remain particularly difficult to study in the deaf child, principally because of the testing problems posed by his language deficiency.

D. The Young Deaf Child

Research on the influence of a language program initiated before the child begins school is not unequivocal. One approach to isolation of the language variable is to compare congenitally deaf children with children who acquire deafness after acquiring at least the rudiments of language. Oleron (1950) compared performance of congenitally deaf children with children who became deaf after five years of age on the Raven's Progressive Matrices. He found the postlingual group to be superior to the prelingual group in their test performance. Levine and Iscoe (1955) administered the Raven's and found no statistically significant difference between congenitally and adventitiously deaf children in their performance.

Pintner and Patterson (1917) were probably the first to systematically assess the language achievement level of deaf children. They used the Trabue Language Test to measure reading comprehension and written language skills. They compared the

performance of congenitally deaf children with children who had lost their hearing after age four but who attended schools for the deaf. They found statistically significant superiority in the adventitiously deaf group over the congenitally deaf group, presumably a function of the language background of the adventitiously deaf group.

More recently, Goetzinger and Rousey (1959) compared the educational achievement of 61 congenitally deaf students and 40 students who had become deaf between the ages of one and three years. The investigators did not report the central tendency or dispersion of ages at which deafness was acquired by the latter group. This information is generally very difficult and often impossible to identify, particularly when one must depend upon the ability of parents to recognize deafness at an early age. Four subtests of the Stanford Achievement Battery were administered to the students, all of whom were adolescents. No statistically significant differences were found between the two groups in their performance on each of the four subtests. Goetzinger and Rousey observed, however, that the congenitally deaf group was of superior mental ability, statistically significant at the 5 per cent level of confidence. A non-parametric test was used to test for differences. A stronger parametric test which controlled for differences in mental ability might conceivably have led to statistically significant differences. If one accepts the results of Goetzinger and Rousey's study, it would appear that the amount of language acquired between birth and an unspecified age between one and three years is not a critical variable with regard to subsequent educational achievement.

Another approach to the question of whether an early language experience influences later educational achievement is to evaluate the effects of pre-school training. Some deaf children are systematically introduced to language at age four and sometimes even three, through pre-schools. These pre-schools are generally maintained as an adjunct to a regular school program for deaf children. Other deaf children do not attend these pre-schools but enter directly into the primary grades of the school for the deaf at age five or six.

Scyster (1936) reported that children entering a pre-school at age four showed superiority in social adjustment, reading, lipreading, and speech over a group of children who did not participate in this program. Several weaknesses in the design of Scyster's investigation raise questions about the validity of these findings. The two groups were not controlled for chronological or mental age, hearing loss or for a number of other possibly relevant variables.

Lane (1942) reported that more of those children who participated in a pre-school program were able to attend public secondary schools after completing their elementary education than of those children who did not participate in a pre-school program.

The most systematically controlled study of the effects of pre-school on the deaf child to date was reported by Craig (1962). A total of 151 deaf children, who had been admitted to two pre-schools at ages between 2 years, 10 months and 4 years, 6 months, were compared with 92 deaf children who had entered two schools for the deaf at ages between five and seven years. At the time

they were tested all the students ranged in age from approximately six and one-half years to sixteen and one-half years. Relevant variables such as chronological and mental age, and severity of hearing impairment were statistically controlled. Students were tested for reading comprehension and lipreading skill. In his conclusions, Craig stated, "The results of this study fail to support the hypothesis that the effects of pre-school education would be evidenced by significantly higher lipreading and reading skills favoring pre-school training for deaf children (p. 35)."

Again, research on the effects of the pre-school remain inconclusive. It may be that where no positive influence is evident, the experiences provided at the pre-school level are not fully appropriate to a goal of accelerated communication skill, but may be influential in other areas such as social adjustment.

The research reported to this point only indirectly addresses itself to the question of whether a communication system acquired before entrance to school by the deaf child influences his later language achievement and psychosocial adjustment. Yet, educators and audiologists continue to search for means of diagnosing deafness earlier in the child's life. There is a consensus of opinion that with early diagnosis of deafness, auditory training and other language stimulation can begin with a consequent reduction in the period of language latency.

One deaf child may have acquired postlingual deafness; another, although congenitally deaf, may have been given early language instruction through a pre-school experience. Much of this chapter has been concerned with these two possible influences. A third avenue remains.

E. Manual Communication

The communication system used most frequently among the deaf is commonly known as "sign language." This system, together with supplementary fingerspelling, is accepted as a medium of communication at the advanced level in many schools for the deaf. Stokoe (1960) studied this system extensively and concluded that it contains the basic properties of a language. At least seven textbooks have been written to teach interested persons to sign. The controversy over the use of sign language by deaf children was briefly discussed in the Introduction. The literature, while voluminous, has almost invariably reflected strong bias, pro and con.

F. Teaching Young Deaf Children to Communicate Manually

Considerable interest has been shown recently in the introduction of manual communication to the deaf child when he begins school. Largely through the efforts of Scouten (1960), attention has been given to the advisability of introducing fingerspelling to young deaf children. Morkovin (1960) reported that in Russia, deaf children are introduced to fingerspelling as early as age two, parents being encouraged to learn and to use fingerspelling in the home, with the result that a vocabulary of up to 2,000 words can be developed by age six. Only at this age is the child introduced to speech and speechreading. Russian educators claim these vocal skills are facilitated by the early introduction to fingerspelling. This work may have considerable implications for the education of the deaf in this country, but caution should be exercised because of the differences between the Russian and English languages, particularly with regard to the relationship of the phoneme to the printed or fingerspelled symbol.

Hester (1963) is currently evaluating the effects of introducing fingerspelling to young deaf children in one school for the deaf in this country. Similarly, S. Quigley has begun an extensive experimental study, adding controls, and using a large population of deaf children from numerous schools (University of Illinois, in progress).

G. The Natural Development of Manual Communication in Young Deaf Children

Tervoort (1961) observed that young deaf children, if not provided a systematic communication system, develop esoteric symbols making free use of gestures. These symbols are mostly intrapersonal and are intended to provide some order within the child's universe.

Another group of deaf children has immediate access to a systematic communication system through deaf parents who routinely communicate manually. This is not to say that all deaf parents communicate manually with their deaf child. Many avoid the use of manual communication with their deaf child because they, like hearing parents, wish their child to possess vocalized language skills and are fearful that the use of manual communication will suppress the development of these skills.

Several investigators have compared the school achievement and behavior of deaf children with deaf parents and deaf children with hearing parents. Presumably the variable of interest was not the hearing of the parents per se but the effect of manual communication on the one hand and vocal stimulation on the other of the respective groups of parents.

Goetzinger and Rousey (1959) matched eight adolescent deaf children of deaf parents with eight adolescent deaf children of hearing parents. They were matched on I.Q., C.A., age at school entrance, and years spent in school. The two groups were tested for achievement levels in paragraph meaning, vocabulary, arithmetic reasoning, and arithmetic computation. On only one subtest, arithmetic computation, was there a significant difference. This difference favored the deaf group with deaf parents and was significant at the 5 per cent level of confidence. Goetzinger and Rousey wrote:

> "It would appear that an earlier use of language through the medium of signs did not enhance later educational achievement in paragraph meaning and vocabulary as measured here. One might postulate that later adverse factors such as restricted language experiences in the home could nullify any early gains, if there were such (p. 228)."

Goetzinger and Rousey acknowledged that their investigation was not conclusive. Their sample size was small; they did not report having confirmed that the deaf parents had in fact communicated manually with their children; they tested a limited range of skills.

Quigley and Frisina (1961) compared deaf children of deaf parents with deaf children of hearing parents to determine the effect, if any, of an oral home environment. The former group consisted of 16 students and the latter, 70. All were day students in residential schools. Day students were selected to maximize the effect of the home environment. The deaf students of hearing parents were found to be superior to the deaf children of deaf parents in speech, statistically significant at the 1 per cent level of confidence. No significant difference was found in speechreading. The deaf children of deaf parents were

superior in fingerspelling, significant at the 1 per cent level of confidence, and superior in vocabulary, significant at the 5 per cent level of confidence. It should be noted that both groups were day students. Accordingly, it is not known to what extent, if any, the differences were a function of early methods of communication before the child entered school. It would have been of interest to compare two residential groups, in which case the early communication experience would have become a more dominant factor.

Only one report concerning the relative adjustment of deaf children of deaf and of hearing parents was found in the literature. Brill (1960) hypothesized that deaf children of deaf parents would be better adjusted than deaf children of hearing parents. The rationale for Brill's hypothesis was that because a deaf child has more communication at an earlier age with deaf parents than with hearing parents, the deaf child of deaf parents should experience much less frustration. From this should follow superior adjustment. Brill matched 45 deaf children of deaf parents with 45 deaf children of hearing parents. He devised a five-point rating scale which was administered to selected members of his school staff for the purpose of comparing the two groups.

Brill introduced also a third group of students with deaf siblings and used a Chi square test and a three by five table to determine whether the three groups were drawn from the same population. He arrived at a chi square of 14.86 which, with 8 degrees of freedom, failed to be significant at the 5 per cent confidence level, falling between the 5 and 10 per cent levels. The present

investigators re-examined Brill's data as set forth in his table, and as an alternate test of his hypothesis discarded his group of students who had deaf siblings. Using a two by five table (McNemar, 1962, p. 228), the present investigators found the two groups to be drawn from different populations with regard to their adjustment ratings (X^2=9.96, with df=4, significant at the 5 per cent level of confidence). Brill observed that more deaf children of deaf parents than deaf children of hearing parents tended to receive extreme high and low adjustment ratings, with less in the center of the distribution. Brill raised the question of whether deaf parents tend to be maladjusted, with a reflection on the adjustment of their children, thus counteracting the advantages of early communication. Brill did not report the chronological ages of the students in his investigation. It is conceivable that the tendency of the deaf children of deaf parents to appear at the two ends of the scale was related to chronological age, particularly since all were selected from a residential school. Presumably adjustment was operationally defined by his rating scale. The top rating was, "Very well liked by nearly all others. A good leader." The bottom rating was, "Seems to have serious emotional and social problems." The top rating clearly pertained to a social position, while the bottom rank added the emotional dimension. It may be that the use of a sociometric measure would have been more satisfactory. At any rate, the use of any rating scale to evaluate psychosocial adjustment, including that used in the present investigation, raises the question of validity.

Two facts become apparent from this review of the literature:

1. There is a consensus of opinion that the deaf child who is introduced to, and who can begin to integrate language at an early age, is more likely to reach adulthood with a minimum language handicap than the child who is deprived of such exposure.

2. Research examining this opinion has been extensive, but little is definitive.

Language is many-faceted. No single investigation can hope to resolve the many problems confronting the young deaf child as he reaches for communication.

III. PROBLEM

A. Definitions

The term manual communication refers to the systematic use of manually produced symbols and signs to convey and receive information. This system of communication, described by Stokoe (1960) and others is practiced by many deaf persons. It may include, but is not limited to gestures such as pointing to indicate direction. It may include representations of English printed words through the 26 hand and finger positions representing the English alphabet, and permit two persons who know the system to converse as fluently and accurately as two persons using the medium of speech.

The term early manual communication refers to the introduction of manual communication to the deaf child at or before two years of age.

The terms speech, speechreading, reading, written language and psychosocial adjustment are operationally defined in the Procedure in accord with their respective methods of assessment.

B. Statement

Congenital deafness imposes severe educational restrictions related to an inadequate development of skills in the language used by the general culture. The instruction of deaf children focuses largely on the establishment of such skills. Cognizance of the need to hasten the development of these skills has led to earlier admission to schools, and systematic exposure of the deaf child to language even before he enters school, through programs

established in speech and hearing clinics, and through parent education.

These developments are premised on the assumption that the linguistic development of deaf children will be facilitated by the simulation of a normal language developmental pattern. These programs stress the development of oral language.

More basic and more general than any specific language system is the phenomenon of communication. A communication system independent of the auditory mechanism is available to some deaf children. Many deaf adults communicate manually among themselves. In the event that they have deaf children, they may communicate manually with these children. These deaf children thereby acquire a native communication system which develops in a manner similar to that by which hearing children acquire vocal communication.

Other deaf children are raised in a predominantly oral atmosphere which, because it is not perceived, precludes the relatively spontaneous development of a communication system. In order to communicate they adopt the gross gestures they see their hearing parents use occasionally. These gestures are usually not elaborated because the parents do not know a language system based on signs. They are restricted to represent only a few basic needs and wishes. It is doubtful that in any but rare instances is oral communication established in these early years before admission to school to the point that such children can communicate as freely with their families as can other deaf children who learn a manual communication system from their parents. It cannot be disputed that the latter children have an early

communication advantage.

However, the goal remains of providing each deaf child with communication skills which he can apply in a culture which uses vocal, printed, and written media for communication. If early manual communication thwarts this goal, and if this goal is realistic, then early manual communication can be concluded to have a generally negative influence. If, on the other hand, early manual communication facilitates the attainment of this goal, it can be concluded to have a generally positive influence.

Optimum psychosocial adjustment of the deaf child remains a second goal. Psychosocial adjustment is related to effectiveness of communication. Thus, psychosocial adjustment may be related to early communication in the deaf child.

C. Objectives

The objectives of this investigation were to determine whether early manual communication influences the subsequent acquisition of:

1. intelligible speech,
2. ability to read,
3. speechreading,
4. written language, and
5. psychosocial adjustment.

The nature of any influence was to be determined, also.

IV. PROCEDURE

A. Sample

The design involved matched pairs of subjects because a large number of variables needed to be controlled in a relatively small sample. Variables generally considered relevant to linguistic skill and/or psychosocial adjustment in children include:

a. sex,

b. educational attributes of the school,

c. chronological age,

d. age admitted to school,

e. hearing characteristics,

f. mental ability,

g. socio-economic level of parents, and

h. integrity of the central nervous system.

Disregard for these variables in a sample of quite limited size would lead to considerable sampling error.

The independent variable was early manual communication. Subjects who were most likely to have learned early manual communication skills would be found among deaf children of deaf parents. Zonderman (1959) attributed a relatively small percentage, 4.6 per cent of all deaf children, to have inherited deafness. It seemed quite unlikely that a population large enough to permit normal sampling procedures could be found, and that proved to be the case.

One subject of each matched pair was a deaf child who had learned manual communication from infancy. The other was a deaf subject who had not.

Five schools for the deaf were contacted with regard to participation in the investigation. These schools represented residential and day, oral and combined programs. The student population of these schools totaled 2034 (American Annals of the Deaf, 1963).

School	Location	Classification
American School for the Deaf	W. Hartford, Conn.	combined, residential
Indiana School for the Deaf	Indianapolis, Ind.	combined, residential
Pennsylvania School for the Deaf	Philadelphia, Pa.	oral, residential
W. Pennsylvania School for the Deaf	Pittsburgh, Pa.	oral, residential
W. & E. Martin School for the Deaf	Philadelphia, Pa.	oral, day

Step 1 - Lists of all deaf children of deaf parents were requested of the five schools. The schools were asked to delete students under seven years of age and students in their senior year, because of expected problems in testing.

A total of 146 deaf children of deaf parents was located. The percentage (7 per cent) of the total population of the schools was considerably greater than that reported by Zonderman. A notable exception was the oral day school which had a student population of 202, and reported only five deaf children of deaf parents over seven years and not seniors.

The following information was collected on these 146 deaf children of deaf parents: chronological age, sex, age at admission to school, age at onset of deafness, severity of hearing impairment. The last was measured by pure tone, air conduction audiometry. The severity of hearing impairment was indicated as

the mean decibel loss in the better ear at 512, 1024, and 2048 cycles per second, generally considered to be the speech range. Students whose hearing losses were less than 70 decibels were dropped from the group of 146.

Step 2 - Each of the remaining students was tentatively matched with at least one, usually more, deaf students of hearing parents. Preliminary matching was done on the basis of:

a. same sex,
b. students in the same school,
c. less than 12 months chronological age difference, and
d. less than 12 months difference in ages at time of admission to the school.

All students in the two preliminary groups had hearing losses of at least 70 decibels in the better ear, and the age of onset of deafness was before two years.

In the meantime, further consideration had been given to the selection of the instruments to be used later for testing of language skill. The investigators were forced to the decision to revise upward the basal chronological age of each subject from seven to ten years of age. This in no way jeopardized the objectives of the investigation except to force a reduction in the sample. On the other hand, it would serve to improve the validity of results; eg., written language could be more readily assessed.

This preliminary matching led to 105 deaf children of deaf parents being matched with 337 deaf children of hearing parents, all ten years of age or over.

Step 3 - Questionnaires were sent to the parents of the 442 students selected in Step 2. These questionnaires were accompanied by a letter from the chief administrator of the particular school in which each child was a student.

The questionnaires requested information on numerous points. The major purpose of the questionnaire was to establish whether the parents had used manual communication with their deaf child beginning at infancy. The term "sign language" was used in place of "manual communication" because the former term is probably better known to parents. It was necessary to distinguish between sign language and gestures so it was stated to parents that unless they knew 100 or more discrete "signs" they were not using sign language. Responses to two questions are recorded in Table 1.

Table 1. Responses by parents to two questions pertaining to the use of manual communication

Question	Hearing Parents	Deaf Parents
1. Did you use sign language with your deaf child when he or she was a baby?	Yes - 7 No - 236 Total - 243	Yes - 46 No - 25 Total - 71
2. Do you use sign language with your deaf child?	Yes - 27 No - 216 Total - 243	Yes - 66 No - 5 Total - 71

Several remarkable points can be drawn from Table 1, and they will be discussed later in the report. These responses were used for the purpose of assuring that one member of each pair had learned manual communication from infancy, and that the other member had not. According to the 71 returns from deaf parents, at least 46 deaf children had been introduced to manual communication before entering school. Of 243 deaf children of hearing parents,

at least 216 had not been introduced to early manual communication before entering school. The final sample was selected from among the 46 deaf children of deaf parents and 216 deaf children of hearing parents who made responses appropriate to the investigation.

Step 4 - Before final selection of the matched pairs, it was necessary to consider three more variables.

Numerous tests of mental ability are administered to deaf children. In the case of each matched pair, the children with and without early manual communication were within 10 I.Q. points on the same test. It was possible to match 46 pairs because each deaf child of deaf parents had earlier been tentatively matched with several deaf children of hearing parents.

School files were checked, and conferences held with supervising teachers and principals to determine which students among the 46 pairs had been diagnosed or even were suspected to be further handicapped by a central nervous system involvement. This screening was necessitated by the realization that the deaf child of deaf parents is less likely to have such a disorder than the deaf child of hearing parents, because of the implications of endogenous versus exogenous deafness. Six children were suspected to have such involvement coincidental with deafness, reducing the number of matched pairs of children to 40.

Table 2 describes the sample upon which data on the independent variables were collected. For tabular purposes, subjects with early manual communication will be indicated as members of the manual group, and subjects without early manual communication as members of the control group.

Table 2. Description of 38[1] matched pairs of deaf children

	Manual group	Control group
Number of subjects	38	38
- male	20	20
- female	18	18
Mean age	14 yrs., 5 mos.	14 yrs., 4 mos.
Mean age admitted to present school	5 yrs., 3 mos.	5 yrs., 2 mos.
Severity of hearing impairment[2]	92	96
Mean intelligence quotient	102	104

[1]Absence of two subjects from school when sample was tested for language skill produced final sample of 38 pairs.

[2]Better ear, pure tone, 512, 1024, 2048 cps.

The socio-economic scale of Hollingshead's (1957) Index of Social Position was used to rate the socio-economic level of each family. While matching did not directly consider this variable, the information was collected in the event that it should be necessary to control this variable in the statistical analysis of the data. This was considered a relevant variable in view of research evidence showing a positive relationship between family socio-economic level and proficiency in the language arts.

Table 3 reveals the scale positions on the socio-economic scale of Hollingshead's (1957) Index of Social Position. A scale of one (1) is reserved for higher executives, proprietors of large concerns, and major professionals. A scale of seven (7) indicates unskilled employees.

Table 3. Socio-economic levels of parents, rated according to the Index of Social Position[1]

Scale position	Fathers of manual group	Fathers of control group
1	0	3
2	0	0
3	1	3
4	1	5
5	16	9
6	7	9
7	9	1

[1]Reflects some incomplete data because father deceased, inadequate description of occupation, etc.

B. Dependent Variables

1. Speech - Hudgins (1949) wrote, "A speech intelligibility test involves at least three different components: (1) speakers, who contribute an adequate sample of their performance, (2) test materials, and (3) a jury of listeners who make the final judgment of the speech samples (p. 597)."

The speakers consisted of the 76 matched subjects. A quiet room was provided by each of the schools from which the subjects had been selected. Subjects were tested individually, each test consuming 10 to 15 minutes. Reproduction of their speech was made on a VM four-track tape recorder. Each subject was first given a short passage to read, the amplitude of his speech noted, and the tape recorder adjusted accordingly.

The test materials consisted of four lists of 50 phonetically balanced monosyllabic words developed by Hudgins (1949). As suggested by Hudgins, each of these four lists was scrambled five times by means of a Table of Random Numbers. This led to a total of twenty lists of equivalent difficulty. Every twentieth subject received the same list.

Each test was administered by the same investigator. The typed list was presented to each subject, and the subject's name and the particular form noted for purposes of scoring. The subject was permitted to take as long as he wished to read the list aloud. If he was dissatisfied with his articulation of a word, he was permitted to repeat it. The investigator held an indicator beside each word for at least five seconds so the subject could not speed through the list.

Three judges were employed to evaluate the speech of each subject. These judges had been recently administered pure tone audiometric tests and their hearing was ascertained to be within normal limits. The judges were all graduate students in the Program in Special Education and Rehabilitation of the University of Pittsburgh. All were full-time students preparing to become teachers of the deaf and accordingly had heard frequently the speech of deaf children. Two of the three judges had received their undergraduate degrees in Speech.

The judges spent approximately one hour listening to the speech tapes to give them general familiarity with the quality of the recorded speech. They met on six occasions, each separated by several days, to judge the speech. Each period lasted approximately three hours, with frequent rest intervals. Auditory fatigue among the judges was therefore kept minimal.

Each word was played back once and each judge, who at no time saw a printed list, wrote the word he believed the subject to be saying. The list written by each judge was then scored by the investigators. A perfect score for a particular subject could be 150 if the complete 50 word list was intelligible to all three judges. The use of the 20 forms eliminated the possibility that the judges might memorize the serial order in which the words appeared. The judges had no way of knowing whether a subject was a member of the manual group or the control group, the order of presentation for the two groups being scrambled.

It should be added that the investigators were not concerned about absolute speech scores for each child, but only about whether one group received a higher score than the other. If

absolute scores had been indicated, additional controls would have been warranted, ie., acoustic conditions improved and a recorder of higher fidelity used.

2. Reading - A number of reading tests are favored in schools for the deaf. Among the most frequently used are the Metropolitan Reading Tests.

Form A, Elementary Reading Test of the Metropolitan (1958) was selected to be administered, primarily because of its recently established administration procedures for deaf children (Wrightstone, Aronow, and Moskowitz, 1962). Test 2, Reading consists of nine paragraphs on different topics with 77 multiple-choice items which test general comprehension of the paragraph and specific vocabulary. Norms for deaf children are provided in standard scores and percentile ranks by age group. These norms have been established for deaf children between ten years and 16 years, 5 months, the age range within which most of the subjects in this investigation fell.

This test was administered in accordance with the directions suggested for deaf children, and administered to all the subjects in each school in one sitting.

Percentile ranks and grade equivalents were calculated from the raw scores of each subject. However, because a test for significant differences between the manual and control groups could be most directly made from the raw scores themselves, these were used in the statistical analysis.

3. Speechreading - Again, it was necessary to select a speechreading test from among a number of available tests. The available tests of speechreading can be characterized by their requirement of a live speaker or a motion picture presenting

a speaker or speakers. The use of the live speaker has the advantage of possessing greater face validity, since speechreaders are most frequently required to speechread under this condition. The motion picture, on the other hand, possesses the advantage of adding a control. Some persons are more difficult to speechread than others. This is held constant by the motion picture and general norms can be more easily developed.

The Craig Lipreading Inventory[1] (Craig, 1962) was selected from among various tests for the following reasons: (a) it tests for the ability to speechread both single words and sentences, (b) it is suitable for administering to a relatively broad age range, (c) two test booklets contain pictures which can be marked, so that no premium is placed on the ability to read, (d) the directions are easily understood by deaf children, (e) since the test items are based on multiple-choice, the child does not have to write what he has speechread, (f) it can be used as either a group or individual test, (g) it requires no equipment other than test booklets.

The inventory consists of the following two parts: a 33-item, multiple-choice subtest for word recognition, and a 24-item, multiple-choice subtest for sentence recognition. Craig originally administered the test in four parts, two with and two without amplification.

The same investigator administered the inventory to all 76 subjects, in groups of six or less, and in a uniform manner. No

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[1]Special permission to use this inventory was granted by its author. It is now in press (Am. Ann. Deaf, May, 1964). Additional information can be obtained directly from the author, Dr. William Craig, Oregon College of Education.

amplification was permitted the subjects. The investigator stood approximately 10 feet from the subjects, and gave each word and sentence twice. Each subject speechread the word or sentence twice, once from a full-face position of the investigator and once from a 45-degree angle. Each subtest required approximately 10 minutes to administer.

The score assigned to each student was the sum of the two subtest scores, with a possible top score of 57. It was not considered necessary to treat the two subscores separately since only a single overall score was sought. Since there were nine more items on the word recognition subtest than on the sentence recognition subtest, the former received somewhat more weight on the final score.

4. Written Language - As with the testing of speech intelligibility, no fully satisfactory objective technique has yet been devised to assess written language. At present, the best technique appears to depend on judges to assess language. An earlier study of the written language of the adolescent deaf student by Birch and Stuckless (1963) indicated that if the language of the deaf, written in composition form, is to be assessed, parameters must be clearly established for the student. The quality of the language is dependent upon the topic about which the student is writing.

The subjects were presented a large colored picture, approximately two feet by three feet. This picture contained a scene showing several children crossing a street on their way to school, while a police officer held back the traffic. A dog belonging to one of the children was running across the road with

his master in pursuit. Several copies of this picture were hung about the room so that every subject in the group could see it easily.

The only direction given the subject was, "Write about the picture. Do not write a title. You have half an hour." This was written on a chalkboard as well as spoken to the group, and the word "title" explained for the benefit of those who might not know. Nothing was said to the subjects about a desirable length for the composition and they were free to cease writing when they wished.

Every composition was subsequently copied by a typist to remove handwriting as a variable. Names and other identification were omitted but the balance of each composition left intact, ie., spelling, grammatic errors and indentation were copied as they had appeared in each original composition.

Three judges assessed each composition independently. Two were principals of schools for the deaf, and the third a teacher of language to deaf students. They were given no information about the writers. They were instructed to assign a score as they might to any composition written by a deaf student.

Accordingly, three independent scores were derived for the composition written by each subject. A single score could be obtained for each subject by converting to T scores, thereby giving the scores assigned by the three judges equal weight.

5. Psychosocial Adjustment - As stated in the Review of Literature, it is difficult to obtain a valid estimate of psychosocial adjustment through rating scales. However, if statistically

significant differences appear as a result of obtaining ratings, it is reasonable to consider that some real differences do exist. The real problem is to state precisely what these differences signify. If, however, no statistically significant differences are found, it is quite possible to make the Type II error, real differences in fact existing but not being detected by the instrument. With the above reservations, the investigators selected the Rating Scale for Pupil Adjustment (1953). This scale was designed to be used by teachers of children in grades three through nine, and claims are made that the items indicate a general measure of social-emotional adjustment. Eleven independent sub-scales are contained in the overall scale. However, it is suggested in the accompanying manual that only four sub-scales be used in arriving at a score. These sub-scales, each containing five possible ratings, are: (a) overall emotional adjustment, (b) social maturity, (c) emotional security, (d) impulsiveness. The four concepts are defined so the teacher is presumed to understand what is meant by each, eg., impulsiveness is defined as "the tendency toward sudden or marked changes of mood."

Psychosocial adjustment, then, is operationally defined for the purpose of this investigation as a rating of emotional adequacy in meeting daily problems in school, social responsibility appropriate to a given age, friendliness toward one's social environment, and stability of mood.

An overall score of psychosocial adjustment is obtained by assigning 5 points to each top rating, through 1 point to each low rating, adding the points and arriving at a score which might vary from 4 to 20.

The homeroom teacher of each of the 76 subjects was given a copy of the Rating Scale and asked to rank a particular subject in relation to other deaf children of a similar chronological age with whom he had experience. The scales were scored by the investigators rather than by the teachers themselves. Teachers were also invited to fill out a questionnaire which was relevant to preferred practices in communicating with deaf children in the home and in the classroom. The information derived from these questionnaires will be presented at some future time.

C. General Testing Procedures

The testing in each school required from two to four days. Each school provided a large, quiet room for this purpose.

The subjects in each school were tested in a single group for reading and written language. Each school was generous in adjusting the time schedules of the subjects. Subjects were seated well apart and the tests closely monitored.

The test of reading was administered first. The time permitted for this test was 25 minutes, with an additional 15 minutes reserved for presenting directions. Following the completion of the reading test, subjects were given approximately 10 minutes to relax before beginning to write the picture description which was to be the basis for the assessment of written language.

Some subjects returned in groups of six for testing later the same day and others on succeeding days. It was possible to test both speechreading and speech during the second testing period for each subject. Each group of six was first administered the Craig Lipreading Inventory which required approximately 25 minutes.

Subjects were then permitted to read silently while individual subjects were administered the Hudgins Word List for speech intelligibility in a far corner of the room. Each subject was seated with his back to the group while he was administered this test, in order to reduce distractions. The time required to record the speech sample with each subject varied considerably but generally took 10 to 15 minutes. Several subjects, particularly younger ones, were evidently nervous in taking this test. These subjects were retested again on the same or next day, and their first speech samples discarded.

The Rating Scale for Pupil Adjustment was sent, with instructions, to teachers who completed them and returned them through the mail.

D. Statistical Analyses

Pairs of subjects were matched with regard to numerous relevant variables because each was expected to be related to the five dependent variables. This brought about a relationship between each pair of scores for all the variables. The selection of a relatively small population sample made it particularly advisable to use such a technique as matching to reduce the sampling error of the difference between means on each of the dependent variables.

The chi-square test was used to test the null hypothesis for speech intelligibility. The decision was made to employ a non-parametric test after a marked skewness was noted on the distribution of scores for both groups, with some subjects receiving zero scores.

The words correctly identified by all judges were added to provide a single speech intelligibility score for each subject. Adding the three scores was justified because of the

objectivity of the reference and the chi-square treatment. Adding the scores served also to increase the reliability of the score for each subject.

The scores for each matched pair were compared by means of a chi-square test. When the two scores for a matched pair of subjects were equivalent, this pair was deleted from the analysis.

Raw scores on the test of reading were used as the basis for the statistical comparison of the two groups on this variable. Grade equivalents were recorded for descriptive purposes as were percentile ranks. It must be remembered, however, that the ceiling for which norms have been developed for deaf students is 16 years, 5 months. The t test was used to compare the two group means. The formula was selected to accommodate the expected correlation coefficient between the pairs of observations under the matched pairs design. The t ratio was calculated as the difference between the means divided by the standard error of the difference (Edwards, 1950, p. 276).

A similar technique was used as the basis for the comparison of the two groups on the variable of speechreading. Sub scores on words and sentences were added to provide a single raw score on each subject. One subject was absent when the groups were tested for speechreading. That pair was dropped from the analysis on these two variables, giving 37 pairs.

An intermediate statistical operation was conducted before the t test was applied to compare the two groups with regard to their written language performance. Three judges had evaluated each composition, each assigning every composition a score. The

three scores were not directly additive. The scores assigned by each judge to the 76 subjects were converted into T scores, with an arbitrary mean of 50, and a standard deviation of 10. The mean T score for each subject was then calculated and a t test conducted on the resulting 38 pairs of scores.

The psychosocial adjustment scores were derived directly from the weighting system suggested by the developers of the test employed. A t test was similarly applied to the resulting 38 pairs of scores.

Information on the socio-economic level of the father of each subject had been collected in the event an analysis of covariance seemed advisable. In this case, the socio-economic variable could serve as the covariate. It became evident after inspection of this information (Table 3) that the control group was favored in terms of socio-economic level. Chi-square tests were applied to the data on each of the dependent variables before the administration of t tests. Results of these preliminary tests indicated that control of the socio-economic variable would be unnecessary.

V. RESULTS

A. Comparison of Two Groups

1. Speech - The mean number of words per subject intelligible to the three listeners is given in Table 4.

Table 4. Mean number of words[1] intelligible to three listeners, with range

Group	Listener I	Listener 2	Listener 3	Range of intelligible words
Manual (n=38)	1.50	1.42	1.34	0-9
Control (n=38)	1.87	1.34	1.68	0-9

[1]of possible 50 words

When the three subscores were added for each subject, the scores for each matched pair of subjects were compared. The following table indicates the number of subjects in each group who achieved higher total speech intelligibility scores than their paired counterparts. Also shown is the chi-square (with correction for continuity) used to test whether differences in the two frequencies should be attributed to chance.

Table 5. Frequency of higher speech intelligibility scores achieved by subjects in each matched pair[1], and test of significance

Subjects	Higher score	Chi square	df	p
Manual	14	33	1	NS
Control	16			

[1]8 pairs of subjects achieved same scores

It is evident that the intelligibility of the speech of the two groups did not differ significantly.

2. Reading - The following table indicates for the two groups the grade equivalents based on the general test norms, and percentile ranks based on special norms for deaf students. Scores were derived from administration of a test of the M.A.T.

Table 6. Performance of two groups on Test 2, Elementary Reading Test (Form A, M.A.T.)

Group	Grade equivalent[1]	Percentile rank[2]
Manual	3.9 (n=37)	76 (n=26)
Control	3.4 (n=37)	57 (n=26)

[1]based on general test norms (n=74)

[2]based on deaf norms (22 subjects over age 16 yrs., 5 mos. deleted from figures)

It is noted that the mean grade equivalent for the manual group was higher than that of the control group. Both groups scored above the median for deaf students on whom the norms were based. It should be pointed out that the early matching may be responsible in part for this fact, particularly insofar as children suspected of central nervous system involvement had been deleted. In addition, it is conceivable that the schools selected for this investigation are not representative of schools for the deaf nationally.

A t test was applied to the raw scores of the two groups. The results of this test are shown in Table 7.

Table 7. Comparison of reading raw scores for two groups

Group	Mean raw score	Standard error[1]	t	P
Manual (n=37)	24.4			
		1.393	3.80	<.01
Control (n=37	19.1			df=36

[1]of difference between means

The difference between the reading raw scores of the two groups was statistically significant at the 1 per cent level of confidence. Examination of the means revealed the manual group to be superior.

3. Speechreading - The following table indicates the mean scores for the two groups on word and sentence recognition on the Craig Lipreading Inventory.

Table 8. Scores of two groups on the Craig Lipreading Inventory

Group	Word recognition	Sentence recognition	Total
Manual (n=37)	24.8	17.9	42.7
Control (n=37)	23.1	16.1	39.2

The manual group received a higher mean score on both the word recognition and sentence recognition subtests of the test of speechreading. The two scores for each subject were totaled. These scores were compared by means of a t test. The results of the administration of this test are revealed in Table 9.

Table 9. Comparison of total scores of two groups on Craig Lipreading Inventory

Group	Mean total score	Standard error[1]	t	p
Manual (n=37)	42.7			
		1.614	2.17	<.05
Control (n=37)	39.2			df=36

[1]of difference between means

The differences between the means was significant at the 5 per cent level of confidence, the difference favoring the manual group.

4. Written language - The raw scores for the combined groups as assigned by three judges to their compositions are described in Table 10.

Table 10. Scores assigned by three judges to 76 compositions

	Judge 1	Judge 2	Judge 3
Mean	57	68	48
Standard deviation	23.60	17.19	18.15

A considerable difference is noted in the mean scores assigned by the three judges to the same compositions. Each score assigned by each judge was converted into a T score with a mean of 50 and a standard deviation of 10. A mean T score was derived from the three T scores initially assigned to each subject. The mean T scores for the two groups were compared by means of a t test. The results are shown in Table 11.

Table 11. Comparison of T scores of two groups on written language.

Group	Mean T score	Standard error[1]	t	p
Manual	52.57			
		1.411	3.351	<.01
Control	47.84			df=37
Total mean T score	50.20[2]			

[1]of difference between means

[2]minor discrepancy due to rounding off each T score

The difference between the means was significant at the 1 per cent level of confidence, this difference favoring the manual group.

5. Psychosocial adjustment - The mean scores assigned on the Rating Scale for Pupil Adjustment by the teachers of the 76 subjects and a test of the significance of their difference is shown in Table 12.

Table 12. Comparison of scores of two groups on Rating Scale for Pupil Adjustment

Group	Mean score	Standard error[1]	t	P
Manual	14.71	.5588	2.022	NS df=37
Control	13.58			

[1]of difference between means

Table 12 reveals that the difference between the mean scores on the scale of psychosocial adjustment was not significant at the rigorous 5 per cent level of confidence. However, it should be noted that a marked trend in favor of the manual group was noted, with a difference significant at the 6 per cent level of confidence.

B. Discussion

The deaf children who had learned to communicate manually from infancy were superior to the deaf children who had not been introduced to manual communication at least until they began school on three of the five dependent variables. Superiority by the first group was evident in reading, speechreading, and written language (5 per cent level of confidence or beyond).

No significant difference was found in the intelligibility of the speech of the two groups. While the difference between the psychosocial development of the two groups was not significant at the 5 per cent level of confidence, it is highly probably that a real difference exists, favoring the group with early manual communication. The difference was significant at a less rigorous 6 per cent level of confidence.

An inspection of the mean raw scores on the test of speech intelligibility (Table 4) reveals that very few words recorded

by the subjects were intelligible to the three listeners (approximately 3 per cent). Hudgins (1949) had found the mean percentage of intelligible words to be 42 per cent among another population of deaf students. Hudgins had also found scores to be normally distributed. It was apparent that speech intelligibility scores in this investigation concerned with early manual communication were not normally distributed, there being a number of zero scores. For this reason, a non-parametric statistical test was administered.

It is highly improbable that the population tested in this investigation and in Hudgin's investigation differed sufficiently to account fully for the considerable difference in mean scores. The difference could be in part explained by the conditions when the speech samples were recorded. Higher scores would have been obtained if special acoustically treated testing rooms and a tape recorder of higher fidelity had been used. Coaching each subject on each word before it was recorded would also have produced higher scores.

Hudgins pointed out that monosyllabic word lists present a difficult test, particularly when used to test intelligibility of speech of deaf children. He demonstrated that sentence lists yield higher scores.

The conditions for recording speech may have been adequate for the purpose of this investigation, which was not to determine absolute levels of performance but simply to compare two groups. Adverse testing conditions influenced both groups equally. However, neither the test and testing conditions for speech intelligibility nor the statistical treatment (Table 5) can be considered entirely adequate for the purpose of testing for differences between the two groups. This test will be discussed further under "Implications for Further Research."

Three measures of central tendency for the two groups in reading were computed. Higher performance was found for the group learning manual communication at infancy on all three measurements. The overall mean grade equivalent for the manual group was 3.9, and for the control group, 3.4. The manual group, then, was approximately one-half a school year ahead of the control group in reading. A conversion of raw scores to percentiles based on national norms for deaf students of the same ages revealed that the manual group stood at the 76th percentile and the control group at the 57th percentile (Table 6). In spite of what appear to be low grade equivalents for students whose mean chronological age was 14 years, 4.5 months (Table 2), the overall sample in this investigation scored above the median for deaf students nationally. The question might be raised as to why one or both groups did not fall closer to the 50th percentile. It will be recalled that numerous students were deleted from the sample because of suspected central nervous disorders. In addition, there was probably a selective factor operating because of the matching procedure. The intelligence of deaf children of deaf parents is probably normally distributed. The distribution of intelligence of deaf children generally may be skewed to the right, due to the relatively high frequency of mentally retarded deaf children (etiological factors frequently producing two or more concomitant handicaps). Matching would produce a normal distribution, but a distribution nonrepresentative of the general population of deaf students.

The group which learned to communicate manually at infancy achieved higher mean speechreading scores on both word and sentence

recognition than the control group (Table 8). The two raw scores were totaled for each subject. Because the word recognition sub-test had more items than the sentence recognition sub-test, total scores were probably slightly weighted toward word recognition. Until various measures of the validity of the test are established, a difficult task because of the absence of objective criteria, correct weighting cannot be determined.

The Craig Lipreading Inventory was found to be an excellent instrument, holding the interest of the subjects well. From the mere fact that a statistically significant difference was found between the two groups (Table 9) the test proved itself a reasonably discriminating instrument.

It is apparent that the three judges who evaluated the written language of the two groups used a different base for their evaluations. Two of the three judges differed by 20 points in the mean of the scores they assigned, and standard deviations varied up to almost five points, forcing a conversion to T scores. After this conversion, a strong relationship was noted among the T scores on each subject by each judge. An extension of this aspect of the investigation is planned to provide a correlation matrix which will provide information on the degree of relationship existing among the three judgments. It is expected to be high.

The mean T score for the group which learned to communicate manually at infancy was almost one-half standard deviation above the mean T score for the control group, a considerable difference which proved statistically significant at the 1 per cent level of confidence.

Finally, the mean score on the test of psychosocial development of the group which learned to communicate manually at infancy was higher than that of the control group. This difference failed to be significant at the 5 per cent level of confidence. Significant at the 6 per cent level of confidence, the difference is probably a real one, not detectable with testing instruments currently available.

Two of the five dependent variables involved the direct recognition or production of language. On these two variables, reading, and written language, the group which learned to communicate manually at infancy was superior. Reading and written language as assessed in this investigation clearly required an ability not only to manipulate symbols but to attach appropriate meaning to them.

Speechreading (in which skill the manual group was also significantly superior) and speech intelligibility (in which skill no statistically significant difference between the two groups was found) can in principle be developed as skills without attachment of appropriate meaning. It is possible to articulate a series of phonemes without awareness of meaning just as it is possible to associate a labial movement with a written form. These two skills are, however, important mediating devices between the deaf person and the person with whom he is verbally interacting. As these two variables were assessed in this investigation, they were language-mediating skills and not basic language skills. This is not to say that a test of speechreading could not be loaded with a greater language factor than was present in the test used in this investigation (eg., response to directions given orally

but without amplification). Similarly, spoken language could be assessed through an evaluation of the spontaneous speech of a child.

Table 1 revealed that hearing parents rarely communicate manually with their deaf infants. Few hearing parents of deaf children use manual communication even when their deaf children reach adolescence. Questionnaires returned by 243 hearing parents indicated that only 27 parents, or 11 per cent, use manual communication. This is a remarkably low figure when it is considered that over 50 per cent of their deaf children attend schools which advocate the qualified use of manual communication. The inconsistency is evident. Also noteworthy is the fact that while 93 per cent of the deaf parents use manual communication with their deaf child at present, 35 per cent of these same parents refrained from the use of manual communication with their deaf child when he was an infant. The reason for the restraint of many deaf parents to use manual communication with their deaf infant is open to conjecture. It is likely that they feel manual communication to be detrimental to the early development of speech.

Another point of interest pertains to the number of deaf children of deaf parents located in the residential and day schools. A precise percentage was not obtained because of the fact that the number of deaf children under seven years whose parents were deaf, and deaf seniors with deaf parents, was not counted. Even without these children, deaf children of deaf parents comprised over 7 per cent of the total population of the schools participating in the investigation. This is substantially higher than the percentage reported by Zonderman (1959). In contrast with the percentage located in residential schools, the one participating

day school produced only five children, or less than 2 per cent of its total population. From this it might be inferred that deaf parents tend to elect to send their deaf children to residential schools, perhaps because most deaf parents had themselves attended residential schools prior to the recent accelerated growth of day programs.

Finally, the information collected on the relative socio-economic positions of the two groups of parents warrants passing attention. The Index of Social Position (Hollingshead, 1957) was used to classify occupations of the fathers of the subjects in the two groups (Table 3). The hearing fathers were relatively evenly distributed over the seven scale positions, three in highly skilled and financially remunerative positions, and one in unskilled labor. In contrast, no deaf father was found in the top two scale positions, and no father was found in the bottom position. Almost all were employed in skilled or semi-skilled manual positions. This is probably a function of the fact that almost all male deaf students receive vocational training in conjunction with their academic studies. The fact that only two of twenty-five deaf fathers fell above the fifth position in the seven point scale, probably reveals the limited opportunity of deaf men to advance into high occupational positions.

C. Conclusions

1. Early manual communication appears to have no influence on the intelligibility of the deaf students' speech. This conclusion is drawn cautiously due to the unsatisfactory methods of testing for differences in the speech intelligibility of deaf children with and without early manual communication.

2. Early manual communication facilitates the acquisition of language in deaf students as manifest through comprehension in reading.

3. Early manual communication facilitates the acquisition of speechreading skills in deaf students.

4. Early manual communication facilitates the acquisition of language in deaf students as manifest through written expression.

5. Early manual communication has no negative influence on the psychosocial development of deaf children and probably has the effect of producing a level of psychosocial adjustment superior to that of the deaf child without such a communication system.

Where differences exist in the basic language and language-mediating skills of deaf children with and without an early manual communication system, such differences favor the deaf child with the early manual communication.

It should not be inferred from these conclusions that the development of early manual communication skills produces a linguistically normal child. The reading level of deaf children who have acquired such skills remains low relative to that of the non-hearing impaired child. The intelligibility of the speech of the deaf child with early manual communication does not appear to be different from that of the deaf child without such an early communication system.

It must be stressed also that early manual communication,and not early vocal communication, was selected as the independent variable. Nothing was concluded with regard to the effect of the early development of a vocal communication system. It is evident.

that the early development of a vocal communication system will result in the establishment of vocal communication skills as tested in adolescence. Only the feasibility of establishing early vocal communication skills in large groups of deaf children is questioned. If a satisfactory vocal communication system can be established in the young deaf child, then the need for a special educational program for him is reduced or becomes unnecessary. Within the foreseeable future, techniques for building such a communication system in the very young deaf child are not likely to be forthcoming. In the meantime it is concluded that the very young deaf child who is provided a manual communication system develops subsequent reading, written language and speechreading skills superior to the deaf child without the early acquisition of manual communication.

VI. IMPLICATIONS

A. Immediate Practice

The primary implication of this investigation is to draw attention to a communication system which, when acquired by the young deaf child, can facilitate the acquisition of certain language skills after the child enters school. Deaf parents can be encouraged to introduce manual communication to their young deaf children without fear of jeopardizing the development of conventional language skills when their children enter school.

Most hearing parents use gestures with their deaf children. These gestures should not be confused with manual communication as tested in this investigation. Gestures, if used, should be replaced by formalized manual symbols. Many urban centers provide classes for interested persons in sign language, and numerous excellent text materials are available.

The experimental group in this investigation consisted of deaf children of deaf parents. Deaf parents typically communicate manually with regularity. In the absence of more detailed research, it would seem desirable for parents to endeavor to interract with the young deaf child through the regular and consistent use of manual communication.

The above recommendation is qualified by the following cautions:

1. The effect of maintaining the use of manual communication into the preschool and primary grades is not known. This investigation limited itself to a study of the effect of early manual

communication only. Formal instruction for all the children for at least the first several years of school was purely oral. It would be erroneous to conclude on the basis of the evidence of this investigation that manual communication should be continued into the preschool and primary grades.

2. The general superiority of the early manual communication group over the group which did not receive early manual communication should not be construed to imply that no alternatives to, or variations of, manual communication remain. However, the superiority of other alternatives or variations remains to be tested through research.

B. Further Research

The conclusions drawn from this investigation depart sufficiently from general opinion and practice to warrant examination through replication. Most residential schools for the deaf contain a sufficiently large population of deaf children who learned manual communication from infancy to make this possible. If a sufficient population of such children in day programs can be located, the investigation could also be extended to determine the influence of daily exposure to manual communication in the home during a period when the child is learning conventional language skills in school.

It seems desirable to initiate research to systematically introduce several groups of young deaf children to various methods of communication from infancy. One group might be introduced to manual communication as was the experimental group in this investigation. A second group might be introduced formally to vocal communication training, and a third group to fingerspelling, or an early period of manual communication with a gradual shift to fingerspelling.

As was indicated in the Discussion, two of the five methods used to test the five dependent variables in this investigation proved barely adequate. These were tests of speech intelligibility and psychosocial development. Improvement of techniques used to test these two variables is indicated.

VII. SUMMARY

A group of deaf children who had learned to communicate manually from infancy was compared on several dependent variables with a group of deaf children who had not learned a system of manual communication before entering school. A matched pairs design was used to control such relevant variables as chronological and mental age, sex, and age at admission to school.

The two groups were compared with regard to speech intelligibility, speechreading, reading, written language, and psychosocial adjustment.

Deaf children who had learned to communicate manually from infancy were found significantly superior to the group without such an early communication system in speechreading, reading, and written language. There was a tendency toward higher scores for the early manual communication group on scale of psychosocial adjustment, significant at the 6 per cent level of confidence. No significant difference was found between the two groups in the intelligibility of their speech.

It was concluded that when the influence of early manual communication on the language of deaf children is present, this influence is in the direction of facilitating the development of conventional language skills.

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